

Analytical Pattern Recognition of Intonation Contours: Automated Tonal Labeling and Class Feature Extraction Using Linguistic Fuzzy Quantifiers

From suggestions of attendees of the ICPP 2011, I have developed my methodology into a semi-automated system of analytical pattern recognition of intonation contours. The non-automated part resides in the manual segmentation into syllables of the sentences contained in the corpora used in the development of the pattern recognition system.

The automated system comprises a module of tonal labeling based on a human-like analytical approach that interprets instances of intonation contours as a vector of features organized in a structure. Tonal labeling is achieved in terms of tonal targets by analyzing each instance of an intonation contour into the “4-layer structure”. This structure has 4 hierarchical tiers, each tier emanating from the tiers below it: tier 1) the raw data of the f_0 contour; tier 2) scalar quantization, normalizing sentence, syllable duration, and f_0 span; tier 3) isometric syllabic pre-tones, encoding the alignment of f_0 events with the syllabic structure; tier 4) string of tones anchored to the isometric syllable structure. Overall, the automated labeling is entirely based on Pierrehumbert’s idea that “*the same intonation pattern lives up with different texts; the crucial points in the contour, the f_0 targets, can be lined up with crucial points in the text, with stretches in between computed accordingly*”. Thus, contrary to other automated modeling tools, my system relies on human linguistic fuzzy (or vague) quantifiers to compute the stretches of a structure (higher and lower for f_0 , before and after for alignment); it interprets the tonal targets of a contour in terms of relative contrast between elements of the intonation structure and not as a sophisticated mathematical or statistical function. The automated labeling system makes it possible to process a (very) large number of instances from a corpus, as well as single sentences if need be.

The labeled data is passed on to the second module: the fuzzy classifier. The classifier uses distributional frequency and degrees of similarity between features to abstract (i.e. calculate) the prototypical pattern of an intonation contour from the analysis of its variation among instances.

For my research, I have used three corpora of about 2000 elicited instances of intonation contours. The first corpus contains instances of closed question in French. The other two contain variations of this first contour in that participants were asked to express disbelief in their question intonation, as “doubt” in one case and as “surprise” in the other case.

The output of the system makes it possible to qualify and quantify categorial properties for each of the three contours, and to establish a proto-grammar of the intonation of three modalities of question in French, in terms of binary and gradient feature oppositions.

